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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 400

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. PROFESSIONAL PAPER October 26, 1916

EXPERIMENTS WITH MARQUIS WHEAT

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By

CARLETON R. BALL, Agronomist in Charge, and J. ALLEN CLARK,
Scientific Assistant, Western Wheat Investigations,
Office of Cereal Investigations

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WASHINGTON
GOVERNMENT PRINTING OFFICE
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INTRODUCTION.

Marquis wheat has attracted much attention in the United States during the past three or four years. Large quantities of seed have been imported from Canada and sold to farmers in this country. In a period of only three years the production has increased until it has become of commercial importance.

The United States Department of Agriculture has had Marquis wheat under experiment at a number of experiment farms for periods of two or three years. These experiments have been conducted under varying conditions of climate and soil. The results obtained in these tests are shown in this bulletin. In addition, there are given some results obtained independently by State agricultural experiment stations.

The experiments at Ames, Iowa; Brookings, Highmore, Eureka, and Newell, S. Dak.; Dickinson and Williston, N. Dak.; Moccasin, Mont.; Nephi, Utah; Aberdeen, Idaho; and Moro and Burns, Oreg., are conducted in cooperation with the agricultural experiment stations of those States, respectively. The experiments at Akron, Colo., are conducted in cooperation with the Office of Dry-Land Agriculture

NOTE.—This bulletin is intended for agronomists, both experimenters and extension workers, and for technical workers in other lines who are concerned with wheat and its products.

Investigations, and those at Newell, S. Dak., in cooperation with the Office of Western Irrigation Agriculture, both of the Bureau of Plant Industry. The results at Archer, Wyo., were obtained in cooperation with the State board of farm commissioners.

The results at St. Paul and Crookston, Minn.; Langdon and Edgeley, N. Dak.; Lincoln and North Platte, Nebr.; and Davis, Cal., were obtained independently by the agricultural experiment stations of those States. The writers desire to acknowledge their indebtedness to the directors and other officers of these stations and substations for their courtesy in permitting the use of these results. Full credit for these data is given in the text in each case.

The data from Huntley, Mont., and the Truckee-Carson Reclamation Project in Nevada were furnished by the Office of Western Irrigation Agriculture of the Bureau of Plant Industry.

HISTORY OF MARQUIS WHEAT.

It is fortunate that in the case of Marquis wheat its origin is fairly well known and the main facts of its subsequent history can be traced.

The Marquis variety is a hybrid wheat bred by the cerealists of the Dominion Department of Agriculture, at Ottawa, Canada. The present Dominion cerealist has given an account of its origin in the following words:[1]

ORIGIN.

A few details in regard to the origin and characteristics of Marquis wheat were given in the report of the Experimental Farms for the year 1906. It seems necessary, now, to treat this subject at somewhat greater length, in view of the exceptional interest which has lately been aroused in this wheat.

Among the crosses made by the director of experimental farms and his assistants during the first few years after the farms were established, several were effected between Red Fife and various early-maturing wheats from Europe and Asia. All the details in regard to the origin of Marquis are not available, but it is one of the descendants of a cross between an early-ripening Indian wheat, Hard Red Calcutta (as female) and Red Fife (as male). The cross (as appears from unpublished notes) was made by Dr. A. P. Saunders, probably at the experimental farm at Agassiz, in the year 1892. The crossbred seeds, or their progeny, were transferred to Ottawa and when the writer of this report was appointed in 1903 to take charge of the work of cereal breeding, he made a series of selections from the progeny of all the crossbred wheats which had been produced at Ottawa up to that time. Some of these had been named and others were under numbers. Though they had all been subjected to a certain amount of selection, each of them consisted of a mixture of related types. In some cases all the types present were similar. In other instances striking differences were observed. The grain which had descended from the cross referred to above was found by careful study of individual plants (especially by applying the chewing test to ascertain the gluten strength and probable bread-making value) to be a mixture of similar-looking varieties which differed radically in regard to gluten quality. One of the varieties isolated from this mixture was subsequently named

[1] Saunders, C. E. Marquis wheat. *In* Canada Exp. Farms Rpts. [1911–1912], p. 118–120. 1912.

Marquis. Its high bread-making strength and color of flour were demonstrated in the tests made at Ottawa in the early months of 1907, and all the surplus seed was at once sent to the Indian Head Experimental Farm for propagation.

It will be clearly seen from the above account that the question, "When was Marquis wheat originated?" can never be answered. It came into existence probably at Ottawa between the years 1895 and 1902. It remained, however, mixed with other related sorts until discovered by the writer in 1903. It was first grown in a pure state in 1904, when a few seeds were sown in a sheltered garden on the Central Experimental Farm. Even then, however, its fine qualities were only partly known, and it was not until the cerealist's baking tests of 1907 were completed that he decided to send out this wheat for trial in Saskatchewan. Its success in the prairie country was phenomenal.

EXPERIMENTS IN WESTERN CANADA.

Marquis wheat was first sent to the Prairie Provinces of Canada in the spring of 1907. The report states that it immediately won a phenomenal success. This success was not due to any lack of able competitors.

For nearly two decades previous to 1907 the Red Fife had been the most popular and highest yielding wheat grown in the Prairie Provinces of Canada. It had been grown in a varietal test at the Indian Head Experimental Farm in Saskatchewan continuously since 1888. Within this 18-year period, 98 other varieties were compared with the Red Fife. Only two of these, the White Fife and Red Fern, were grown throughout the entire 18 years. The average acre yield of the Red Fife during this period was 37.6 bushels. It outyielded both other varieties, though the average acre yield of the White Fife was 36.4 bushels.

At the Brandon Experimental Farm in Manitoba, the Red Fife was grown continuously for 17 years, 1890 to 1906, inclusive. During all or varying parts of this period, 85 other varieties and strains were compared with it. Only five others were grown throughout the 17 years. The Red Fife, with a 17-year average acre yield of 33.7 bushels, outyielded all the others except one. This one was the White Fife, with an average acre yield of 34.2 bushels.

These data show the Red Fife and White Fife to be good varieties and that any variety outyielding them must possess real merit.

Marquis wheat was introduced into experiments at Indian Head, Saskatchewan, in 1907; at Brandon, Manitoba, and Lethbridge, Alberta, in 1908; and at Rosthern, Saskatchewan, in 1911. Table I shows the yield of the Marquis and Red Fife varieties at these stations from the year of introduction to 1914 and the average yield of each in the period during which they were grown. These data have been taken from the published annual reports of the Canadian experimental farms.

TABLE I.—*Annual and average yields of Marquis and Red Fife wheat, grown at four of the Canadian experimental farms during varying periods within the years 1907 to 1914, inclusive.*

Station and variety.	Yield per acre (bushels).								
	1907	1908	1909	1910	1911	1912	1913	1914	Average.
Indian Head, Saskatchewan:									
Marquis	32.0	46.3	37.5	48.0	50.4	77.4	56.7	54.0	50.3
Red Fife	12.0	35.0	24.8	43.0	26.4	64.0	39.3	46.7	36.4
Brandon, Manitoba:									
Marquis	.....	49.2	43.3	42.7	46.6	36.6	50.5	36.5	43.6
Red Fife	.....	41.5	40.2	40.7	42.6	36.0	45.0	22.6	38.4
Lethbridge, Alberta:									
Marquis	.....	29.2	31.0	11.0	.....	28.5	30.0	.....	25.9
Red Fife	.....	33.8	29.0	15.0	.....	31.1	24.7	.....	26.7
Rosthern, Saskatchewan:									
Marquis	.....	.....	.....	.....	70.0	43.3	54.0	45.3	53.1
Early Red Fife	.....	.....	.....	.....	60.0	27.3	36.0	43.1	41.7

A study of Table I shows that the Marquis outyielded the Red Fife at three of these stations by 5 to 14 bushels per acre. At Lethbridge the Red Fife outyields Marquis by four-fifths of a bushel per acre. The Kharkof, a hard red winter wheat, also outyields the Marquis at Lethbridge.

The overyield of the Marquis at Indian Head is 38.2 per cent; at Rosthern, 27.3 per cent; and at Brandon, 13.5 per cent.

INTRODUCTION INTO THE UNITED STATES.

Attention was first attracted to Marquis wheat in the United States through its having won premiums at several expositions. In consequence of this publicity a demand for the seed arose. A considerable quantity of seed was brought into this country for sowing in 1913. Much larger quantities were imported for sowing in 1914. One firm in North Dakota claims to have handled 140,000 bushels in the latter year.

The importations of these two years, with the seed home grown in 1913, were sufficient to sow about half a million acres in 1914. The three States, Minnesota and the Dakotas, produced 6,360,000 bushels in 1914. The total crop of 1914 was probably about 7,000,000 bushels. This gave a large supply of home-grown seed, and very little has been imported since.

Most of the imported seed was sold in Minnesota, North Dakota, and Montana. Smaller quantities were sold in Iowa, Nebraska, South Dakota, and Washington. In this way the Marquis variety became widely distributed in a very short time.

DESCRIPTION OF MARQUIS WHEAT.

In all important characters Marquis wheat closely resembles the wheats of the Fife group, so commonly grown in the northern Great Plains States. It is therefore included in the Fife group. It will be

remembered that the Red Fife was the male parent of the Marquis and that it doubtless was selected for Fife characters.

The Marquis is a beardless spring wheat, with white glabrous glumes and broad and short hard red kernels. In general it differs from the

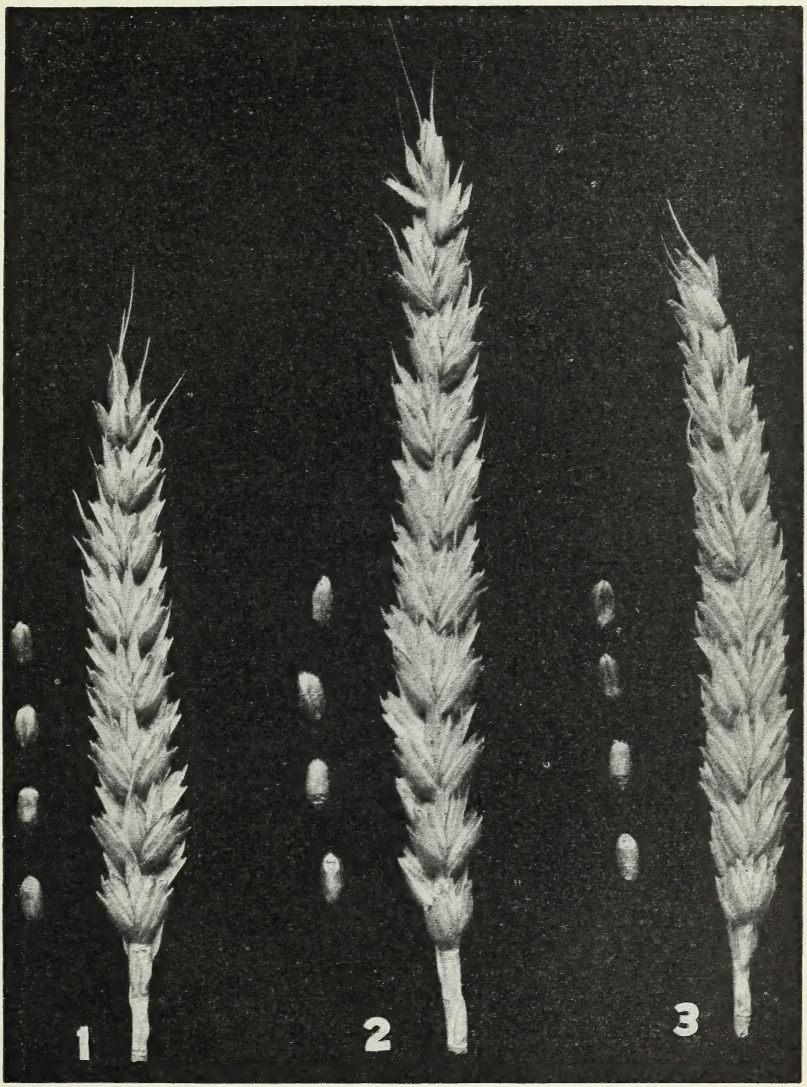

FIG. 1.—Heads and kernels of three varieties of hard spring wheat, natural size: 1, Marquis; 2, Glyndon; 3, Haynes.

true Fife varieties in its shorter straw, shorter spike, shorter glumes, and shorter, broader kernel. (Figs. 1 and 2.)

The plants are of only medium height, ranging from 28 to 48 inches, according to season. They generally are 2 to 4 inches shorter than

those of the Glyndon and Power wheats. The straw is stiff and stands up well under unfavorable weather conditions. The spikes are short, varying from 2.5 to 4 inches in length. They average one-half to 1 inch shorter than those of other varieties of the Fife group (fig. 1).

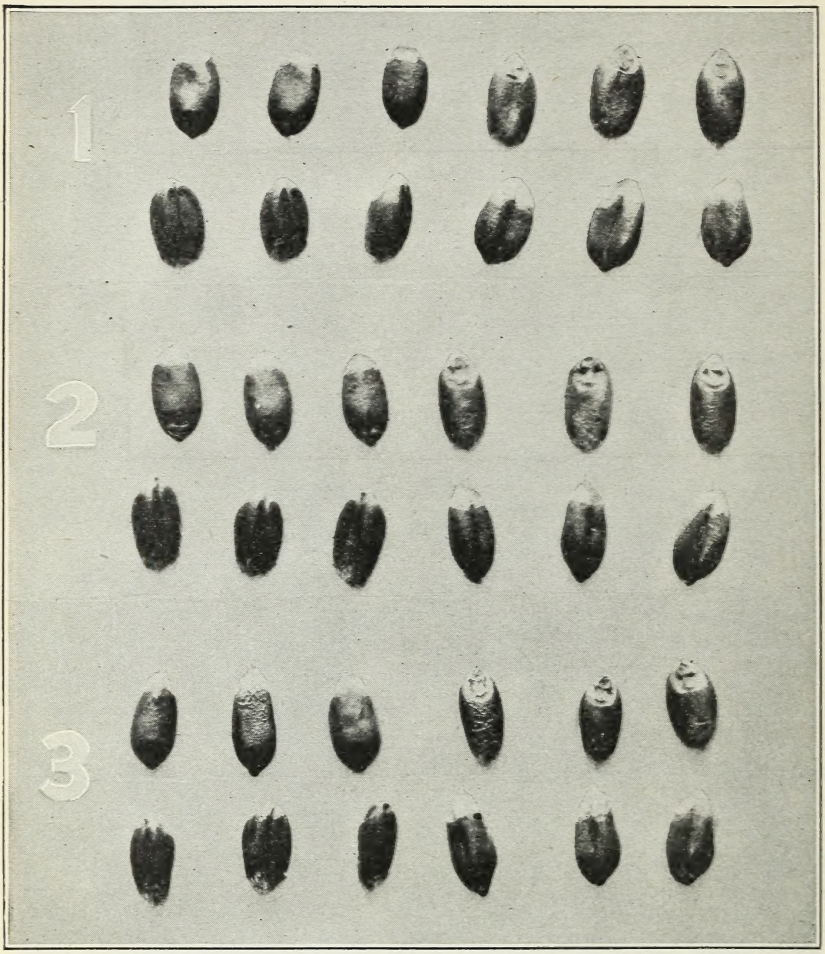

FIG. 2.—Kernels of three varieties of hard spring common wheat, shown in four different positions, twice natural size: 1, Marquis; 2, Glyndon; 3, Haynes.

Two or three short awns usually are found at the tip of the head, as in other beardless wheats.

The glumes of the Marquis variety are short and broad. The variety usually can be recognized, even before the seed is ripe, by this character and by its lower stature. In spite of the short glumes the seed is held firmly and does not shatter.

The kernels of other Fife wheats are short and broad, but those of the Marquis are even more so. They vary from 4.5 to 6 millimeters

in length, averaging 5.2 millimeters, or nearly 1 millimeter shorter than the kernels of Fife and Bluestem wheats (fig. 2). The crease also is broader and deeper.

The Marquis is an early variety, ripening from 98 to 135 days after sowing, varying with the season and locality. The average length of its growing period in the northern Great Plains is about 115 days. This makes it three or four days earlier than most of the other Fife varieties. Because of its earliness it escapes to some extent the drought of dry years, the rust and fall rains of wet seasons, and also the early fall frosts. These are the characters which have made it especially valuable in the Prairie Provinces of Canada.

The growing season lengthens as one passes southward into the United States, and earliness is no longer so great an advantage.

VARIETAL EXPERIMENTS.

As soon as the Marquis wheat began to attract attention in 1912 the United States Department of Agriculture began an extensive series of varietal experiments with it.

SOURCE OF THE SEED.

A small supply of seed (C. I. No. 3276) was obtained from Dr. C. E. Saunders, of Ottawa, in January, 1912. This was grown in the nurseries at several stations, but became the basis of the varietal experiments in plats only at Aberdeen, Idaho, and Newell, S. Dak. A larger supply (C. I. No. 3641) was obtained from the Lethbridge Experimental Farm in Alberta, in the early spring of 1913. This lot has been used in the varietal experiments of the Department of Agriculture, except in Idaho and Oregon and at Newell, S. Dak. In the spring of 1913 the Eastern Oregon Dry-Farming substation at Moro obtained a supply of seed direct from the Indian Head Experimental Farm in Saskatchewan. This lot of seed was given Cereal Investigations No. 4158 and has been used in the varietal experiments at Moro and Burns, Oreg. The sources of the seed used by the State experiment stations conducting independent tests are not known.

GEOGRAPHIC AREA COVERED.

The experiments recorded herein have been conducted in 13 different States. The area stretches from Iowa and Minnesota on the east to California and Oregon on the west. All the intervening States are included except Washington.

In this great expanse of territory the conditions of climate and soil vary greatly. Naturally the adaptation and value of Marquis wheat vary with local conditions. The eastern portion of this territory is distinctly humid in climate, and the soil consists of glacial drift and alluvium. Progressing westward into the northern section of the Great Plains area marked changes occur, especially in the climatic

factors. In general the precipitation decreases, the elevation increases, and the growing season becomes shorter. The soils become heavy clay loams, varying to heavy clays or gumbo on the one hand and to sandy loams and sands on the other.

West of the Rocky Mountains a new set of conditions present themselves. The precipitation usually is low, and sometimes very low. The elevation in the great interior basins is high, except in the Columbia Basin, where it seldom exceeds 2,000 feet. The soils are light in texture. In the California valleys the elevation is low.

In the Rocky Mountain region and westward irrigation is practiced where water and topography permit. Marquis wheat has been tested under irrigation as well as by dry-farming methods in the semiarid and arid portions of the territory covered.

For convenience in presenting the results obtained, the territory under discussion may be separated into four divisions, according to the prevailing conditions. These divisions may be called (1) the northern Prairie States, or subhumid section; (2) the northern Great Plains States, or semiarid section; (3) the Basin and Coast, or arid areas, including the Great Basin, the Snake River basin, the Harney Valley, the Columbia basin, and the California valleys; and (4) the irrigated districts of the northern Rocky Mountain region and Great Basin areas.

RESULTS OBTAINED.

The results of varietal experiments reported in this paper have been obtained at 22 different experiment stations. At 15 of these stations, in nine different States, the experiments are conducted by the Office of Cereal Investigations, usually in cooperation with the State agricultural experiment station or some other agency. At eight different stations in four States the results given have been obtained independently by the State agricultural experiment station or other agency. The source of the data is explained in connection with each station.

The experimental conditions have varied somewhat at some of the stations. The results obtained at one station, therefore, are not necessarily directly comparable with those obtained at another station. In most cases, however, they probably are directly comparable.

In all cases the results from different varieties at the same station were nearly always obtained under similar conditions and may be directly compared. Any known exceptions to this fact are stated in the text.

At each station the aim has been to grow the experimental crops under conditions approximating good farm practice for that locality. All crops have been grown by means of only the natural rainfall except those discussed in the fourth division, which were grown under irrigation.

Results in the Northern Prairie States.

This section covers the northern Prairie States lying west of the Mississippi River. It includes Iowa, Minnesota, and the subhumid eastern parts of Nebraska and the two Dakotas. Only the narrow limits of the Sioux Valley of South Dakota and the Red River Valley of North Dakota can be classed as subhumid in these two States.

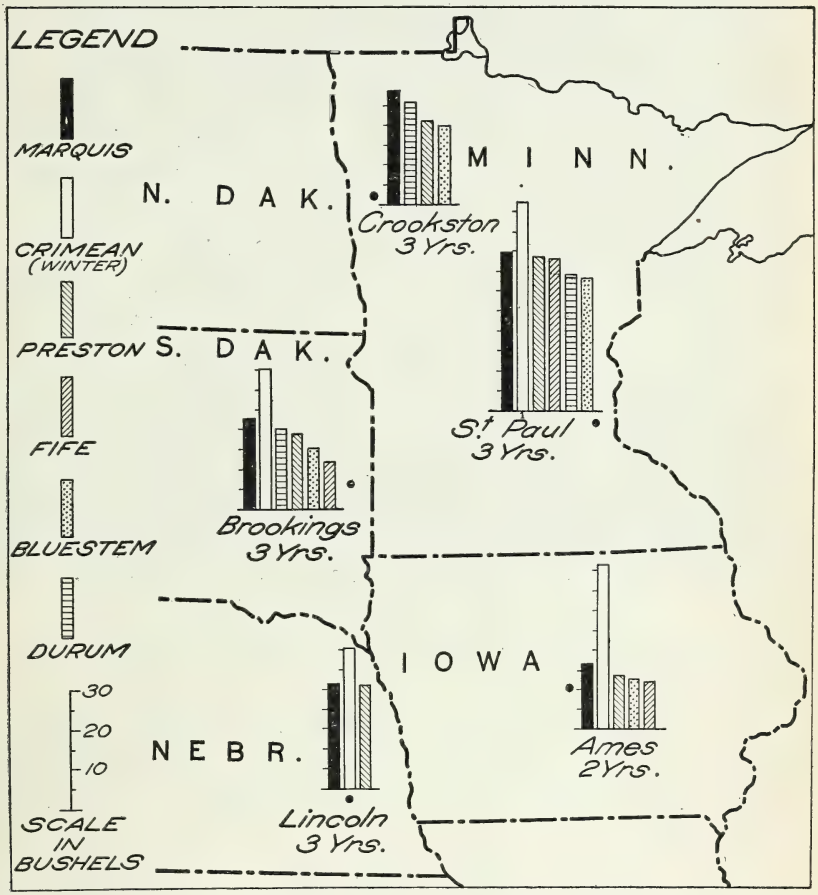

FIG. 3.—Diagram showing the average yields of the Marquis and the leading variety in each of several different groups of wheat at five stations in the northern Prairie States, during either two or three of the years 1913 to 1915, inclusive.

Marquis wheat has been grown to a considerable extent in this subhumid part of the upper Mississippi Valley. About one and one-third millions of bushels were grown in Minnesota alone in 1914. The variety has been tested at several experiment stations located in this section. The positions of five such stations and the results obtained during the last three years are shown in figure 3. The

stations are Ames, Iowa; Lincoln, Nebr.; Brookings, S. Dak.; and St. Paul and Crookston, Minn.

Figure 3 shows by means of graduated columns the average yield of Marquis wheat and of the leading variety in each of several groups of wheat during the 3-year period, 1913 to 1915, except as otherwise noted. The same data will be found in tabulated form in Tables III to VII, inclusive.

The annual rainfall at each of these stations during 1913, 1914, and 1915, so far as available, and the average for the 3-year period, together with the elevation, are shown in Table II. The average annual rainfall at Ames, Iowa, not shown in the table, is about 40 inches. From this there is a decrease at the other stations. Crookston, Minn., has the lowest average, a little less than 20 inches. Brookings, S. Dak., has the highest elevation.

TABLE II.—*Altitude, annual precipitation, and seasonal precipitation at five experiment stations in the northern Prairie States, or subhumid section, during 1913, 1914, and 1915, except as otherwise noted.*

Station.	Altitude.	Precipitation (inches).							
		Annual.				Seasonal.[1]			
		1913	1914	1915	Average.	1913	1914	1915	Average.
	Feet.								
Ames, Iowa	922	.....	(2)	38.66	.....	.....	(2)	12.85	.....
Lincoln, Nebr	1,189	26.23	40.02	36.81	34.35	12.30	20.70	11.81	14.94
Brookings, S. Dak	1,636	16.58	24.15	20.42	20.38	10.69	14.09	10.47	11.75
St. Paul, Minn	837	24.05	24.62	30.79	26.49	13.73	12.65	14.74	13.71
Crookston, Minn	863	16.20	23.03	20.11	19.78	8.62	14.38	14.98	12.66

[1] The records of seasonal precipitation include the months of April to June, inclusive, at Ames and Lincoln and the months of May to July, inclusive, at the other stations.
[2] No records available.

The annual rainfall is usually sufficient for normal crop production. Nearly half of the annual precipitation falls during the four months of May, June, July, and August. The growing season is fairly long, varying from about 130 days to as many as 150 days.

RESULTS AT AMES, IOWA.

As shown in Table III, Marquis wheat has been grown only two years at this station. The data show that the hard red winter wheats of the Crimean group far outyield any spring wheats. The Marquis is compared, however, with three other spring wheats. These varieties represent the three different groups of hard spring common wheat which are extensively grown in the hard spring-wheat States. In these two years the Marquis outyielded them all by 3 to 4 bushels to the acre. Representative heads and kernels of the

Preston (spring common), Kubanka (spring durum), and Crimean (winter) groups are shown in figures 4 and 5.

FIG. 4.—Heads and kernels of three varieties of hard wheat, one-half natural size: 1, Preston (spring common); 2, Kubanka (spring durum); 3, Kharkof (winter).

TABLE III.—*Annual and average yields of the Marquis and six other varieties of wheat grown at the Iowa Agricultural Experiment Station, Ames, Iowa, during 1914 and 1915.*

[Data obtained in cooperation with the Iowa Agricultural Experiment Station.]

Group and variety.	Yield per acre (bushels).		
	1914	1915	Average.
Fife:			
Marquis	12.0	21.0	16.5
Glyndon (Minn. No. 163)	12.0	12.3	12.2
Crimean (winter):			
Turkey (Iowa No. 404)	41.7	40.7	41.2
Turkey	34.1	39.2	36.7
Kharkof	33.3	38.8	36.1
Preston:			
Early Java	11.9	15.3	13.6
Bluestem:			
Haynes (Minn. No. 169)	12.7	13.0	12.9

RESULTS AT LINCOLN, NEBR.

The experiments reported in Table IV were conducted independently by the Nebraska Agricultural Experiment Station, and the results are made available here through the courtesy of its director and other officers. The yields obtained from the Marquis, Turkey,

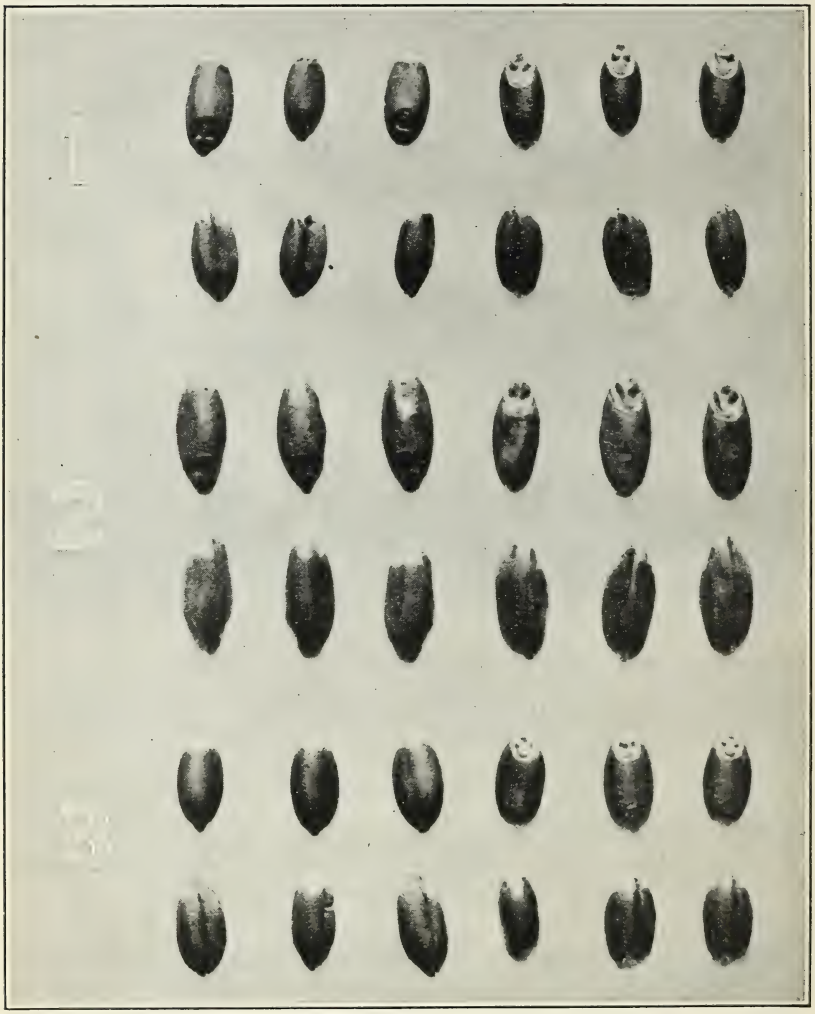

FIG. 5.—Kernels of three varieties of hard wheat, shown in four different positions, twice natural size: 1, Preston (spring common); 2, Kubanka (spring durum); 3, Kharkof (winter).

and Preston varieties during three years are given. The 3-year average yield of the Marquis is about 8 bushels less than that of the Turkey, although it outyielded the Turkey in 1914. Its average yield exceeds that of the Preston, a bearded spring wheat, by only 1.4 bushels per acre.

Concerning the Marquis wheat, Prof. T. A. Kiesselbach, agronomist at the Nebraska Agricultural Experiment Station, says:

It has been our observation that the quality of the Marquis grain is usually somewhat inferior to the grain of the other varieties. The seed is usually more shrunken.

TABLE IV.—*Annual and average yields of the Marquis and two other varieties of wheat grown at the Nebraska Agricultural Experiment Station, Lincoln, Nebr., 1913 to 1915, inclusive.*

[Data presented by courtesy of the Nebraska Agricultural Experiment Station.]

Group and variety.	Yield per acre (bushels).			
	1913	1914	1915	Average.
Fife:				
Marquis	32.6	33.7	16.0	27.4
Crimean (winter):				
Turkey	48.3	28.8	28.7	35.3
Preston:				
Preston [1]	31.6	29.3	16.8	26.0

[1] Average yields of two varieties grown as "Scotch Fife" and "Swedish," both of which proved to be the Preston variety.

RESULTS AT BROOKINGS, S. DAK.

Cooperative varietal experiments with Marquis wheat have been conducted during three years at the South Dakota Agricultural Experiment Station at Brookings. The annual and average yields of the Marquis and eight other varieties, representing five different groups of wheat, are given in Table V.

TABLE V.—*Annual and average yields of the Marquis and eight other varieties of wheat grown at the Brookings (S. Dak.) station, 1913 to 1915, inclusive.*

[Data obtained in cooperation with the South Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3641	29.3	15.8	26.7	23.9
Glyndon	2873	19.2	9.2	7.5	12.0
Crimean (winter):					
Turkey	3055	34.2	30.8	43.3	36.1
Kubanka (durum):					
Kubanka	1440	28.3	15.0	17.0	20.1
Arnautka	4072	25.8	11.2	22.5	19.8
Preston:					
Preston	3081	27.6	12.7	18.3	19.5
Preston	3328	22.3	5.8	21.6	16.6
Bluestem:					
Dakota	3083	26.7	8.3	12.1	15.7
Marvel	3082	22.7	5.7	11.6	13.3

It will be noted that the Turkey, a hard red winter wheat, outyields all spring wheats by more than 12 bushels to the acre. Among the spring wheats, however, the Marquis outyields all other varieties, including five common wheats and two durum wheats. The durum varieties outyield all spring common wheats except the Marquis. The

average yield of the Marquis exceeds that of the Kubanka by about 15 per cent, and that of the best Preston by more than 18 per cent. It much excels the Bluestem varieties and nearly doubles the yield of the Glyndon Fife.

RESULTS AT ST. PAUL, MINN.

The experiments recorded in Table VI were conducted independently by the Minnesota Agricultural Experiment Station, and the results are presented here through the courtesy of the director and other officers.

Table VI shows that in the two years when data on winter wheat are available, the Turkey variety outyielded all the leading varieties of spring wheat. In the 3-year average yield, the Marquis slightly outyields all other varieties of spring wheat. The quantities by which it exceeds the Preston and Glyndon, however, are too small to be significant, amounting to 2.5 and 4 per cent, respectively. The advantage of the Marquis over the Haynes and Kubanka is about 15 per cent in each case. The 2-year average yield of the Turkey is about 35 per cent higher than that of the Marquis.

In correspondence, Profs. Andrew Boss and A. C. Arny state that these varieties were grown on small duplicated plats, 3 by 132 feet, with cultivated 2-foot alleys on either side. The yields, therefore, are higher than those obtained on larger plats and in fields, but are comparable one with another.

TABLE VI.—*Annual and average yields of the Marquis and five other varieties of wheat grown at the Minnesota Agricultural Experiment Station, University Farm, St. Paul, Minn., 1913 to 1915, inclusive.*

[Data presented by courtesy of the Minnesota Agricultural Experiment Station.]

Group and variety.	Minn. No.	Yield per acre (bushels).				
		1913	1914	1915	Average.	
					Two years.	Three years.
Fife:						
Marquis	1239	41.9	27.7	50.0	38.9	39.9
Glyndon	285	38.6	27.0	49.2	38.1	38.3
Crimean (winter):						
Turkey	845	.....	47.8	57.0	52.4	.....
Preston:						
Preston	924	43.5	26.5	46.7	36.6	38.9
Kubanka (durum):						
Kubanka	990	25.7	30.3	46.7	38.5	34.2
Bluestem:						
Haynes	169	33.8	26.7	39.9	33.3	33.5

RESULTS AT CROOKSTON, MINN.

The experiments at Crookston, Minn., have been conducted by the Minnesota Agricultural Experiment Station. The results are available through the courtesy of the director of the station and his asso-

ciates. The Marquis variety has been grown during three years, 1913 to 1915, inclusive, and the annual and average yields of this and other varieties are shown in Table VII. The average yield of each variety is given graphically in figure 3.

The data show that the Marquis outyields any of the other three varieties, representing three separate groups of wheat. It excels the Kubanka by only 5 per cent, but exceeds the Preston and Bluestem by 25 and 30 per cent, respectively. Two plats of Marquis wheat were grown each year, the original seed having been received from separate sources. The yields given are an average of the yields of the two plats. The Glyndon, a Fife variety, was grown in 1913 and yielded 17.4 bushels to the acre, while the two Marquis plats yielded 20.5 and 22.3 bushels, respectively. Winter wheat has not been grown successfully in this part of Minnesota.

TABLE VII.—*Annual and average yields of the Marquis and three other varieties of wheat grown at the Northwest Experiment Station, Crookston, Minn., 1913 to 1915, inclusive.*

[Data presented by courtesy of the Minnesota Agricultural Experiment Station.]

Group and variety.	Yield per acre (bushels).				Group and variety.	Yield per acre (bushels).			
	1913	1914	1915	Average.		1913	1914	1915	Average.
Fife:					Preston:				
Marquis[1]	21.4	23.9	40.0	28.4	Preston	18.2	17.7	28.1	21.3
Kubanka (durum):					Bluestem:				
Kubanka	27.8	14.6	38.0	26.8	Haynes (Minn. No. 169)	17.4	19.2	23.3	20.0

[1] Average of the yields of two lots.

CONCLUSIONS.

Two facts are shown clearly by figure 3 and Tables III to VII, inclusive, on which figure 3 is based. These facts are (1) that where hard red winter wheats of the Crimean group can be grown in this section they outyield any spring wheat, and (2) that Marquis wheat outyields other varieties of spring wheat at all these stations. These results are based on 3-year tests at all stations except Iowa, where they cover only two years.

The gain in yield of the Marquis over other spring wheat varieties belonging to the Fife, Bluestem, and Preston groups is small. At St. Paul, Minn., and Lincoln, Nebr., the difference is only about 1½ bushels. In central Iowa and eastern South Dakota it is 3 to 4 bushels. At Crookston, Minn., however, the difference is about 7 bushels. The gain in yield of the Marquis over durum wheats at the three northern stations in this section varies from 1.5 to more than 5 bushels.

RESULTS IN THE NORTHERN GREAT PLAINS AREA.

The northern half of the Great Plains area includes most of Nebraska and the Dakotas, northeastern Colorado, eastern Wyoming, and the eastern half of Montana.

It was to the northern States of this division that Marquis wheat was first introduced. It is in the Dakotas and Montana that it has

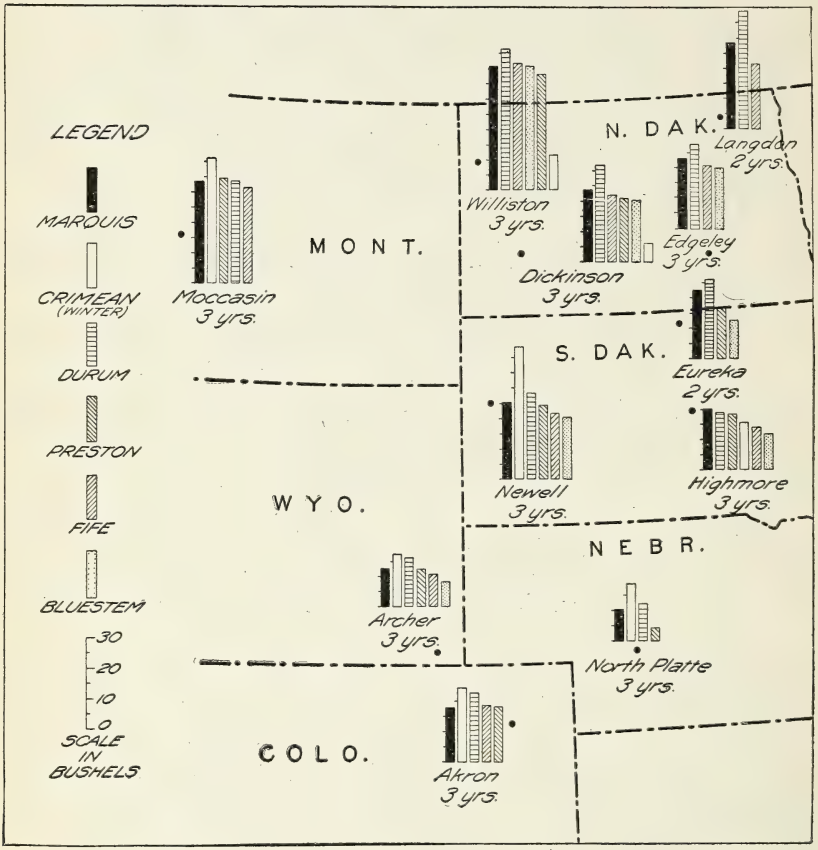

FIG. 6.—Diagram showing the average yields of the Marquis and the leading variety in each of several different groups of wheat at 11 stations in the northern Great Plains area during either two or three of the years 1913 to 1915, inclusive.

become most extensively grown. In 1914 North Dakota alone produced over four millions of bushels and South Dakota nearly a million bushels. No data for Montana were gathered. If statistics for the production in 1915 were available, the increase in these three States would be found to be enormous.

Varietal experiments with the Marquis and other wheat varieties have been conducted under dry-land conditions at nine experiment stations in this section during the three years, 1913 to 1915, inclusive,

and at two others during the last two years of this period. The stations are as follows: North Platte, Nebr.; Akron, Colo.; Archer, Wyo.; Newell, Highmore, and Eureka, S. Dak.; Edgeley, Langdon, Williston, and Dickinson, N. Dak.; and Moccasin, Mont. The location of these 11 stations and the results of the varietal experiments are shown graphically in figure 6. By means of graduated columns the average yield of Marquis wheat is shown with that of the leading variety in each of several groups of wheat grown commercially in these States. The same data will be found in Tables IX to XIX, inclusive.

The climate of this section is generally classed as semiarid. Table VIII shows the altitude of each station and the records of annual and seasonal rainfall during the three years, 1913 to 1915, inclusive, when the varietal experiments were in progress. In the three years under discussion the average annual rainfall has varied between 15 and 20 inches at all these stations except North Platte, Nebr. The higher average at that station is due entirely to the enormous precipitation of the year 1915. In general, the annual rainfall decreases in passing westward across this section. The altitude steadily increases from east to west, varying from 1,000 or 1,500 feet on the eastern border to 6,000 feet in eastern Wyoming and Colorado.

TABLE VIII.—*Altitude and annual and seasonal precipitation at 11 experiment stations in the semiarid northern section of the Great Plains area.*

Station.	Altitude.	Precipitation (inches).							
		Annual.				Seasonal.[1]			
		1913	1914	1915	Average.	1913	1914	1915	Average.
	Feet.								
North Platte, Nebr.	3,000	18.52	16.10	34.85	23.16	9.02	8.12	19.56	12.23
Akron, Colo.	4,560	16.05	15.58	25.00	18.88	6.81	10.67	14.17	10.55
Archer, Wyo.	6,027	16.80	11.60	18.32	15.57	9.26	8.52	12.69	10.16
Newell, S. Dak.	2,950	12.53	11.70	21.02	15.08	5.68	7.03	15.83	9.51
Highmore, S. Dak.	1,890	12.46	17.52	23.29	17.76	8.59	11.98	16.40	12.32
Eureka, S. Dak.	1,884	.....	14.50	24.89	19.70	.....	9.80	12.45	11.12
Edgeley, N. Dak.	1,468	19.82	17.80	21.96	19.86	9.06	13.06	13.88	12.00
Langdon, N. Dak.	1,615	.....	17.43	17.55	17.49	.....	7.42	9.15	8.27
Williston, N. Dak.	1,875	15.27	18.47	14.62	16.12	5.95	12.00	7.23	8.39
Dickinson, N. Dak.	2,453	11.93	22.74	20.53	18.40	5.43	18.84	14.41	12.89
Moccasin, Mont.	4,228	14.96	15.67	20.68	17.10	9.32	9.38	11.06	9.92

[1] The record for seasonal precipitation includes the four months of April, May, June, and July at all stations except North Platte, Nebr., and Archer, Wyo. At North Platte the record is for the four months of March, April, May, and June. At Archer the record is for the five months of April, May, June, July, and August.

Crop production is governed largely by the quantity and distribution of the annual precipitation. Reference to Table VIII shows that one-half to two-thirds of the total comes during the growing season of four months. Wind movement is fairly constant and summer temperatures rather high. These factors cause loss of water by evaporation. Hot winds and hail sometimes occur. Wet, warm weather in midsummer sometimes promotes epidemics of rust.

The length of the growing season varies with the altitude and latitude. The frost-free period decreases from about 130 days in the lower portions to about 90 days at the higher elevations. In general, early and drought-resistant varieties have an advantage in escaping hot winds, drought, and frost. A brief popular classification and description of the important groups of hard spring wheat and the leading varieties in each group is already available.[1]

RESULTS AT NORTH PLATTE, NEBR.

The experiments reported in Table IX were conducted independently by the Nebraska Agricultural Experiment Station, and the results are made available here through the courtesy of the director and other officers. They have been continued through the 3-year period, 1913 to 1915, inclusive.

Table IX shows that the Turkey wheat, a hard red winter variety, largely outyields all the spring wheats. The advantage of the Turkey over Kubanka No. 1, a durum wheat and the highest yielding spring variety, is 54 per cent. The durum varieties slightly outyield the Marquis, while the durums and the Marquis all outyield the Preston. It is unfortunate that no other variety of the Fife group has been grown at North Platte. The results in hand do not show whether or not the Marquis would outyield other Fife wheats.

TABLE IX.—*Annual and average yields of the Marquis and five other varieties of wheat grown at the North Platte substation, 1913 to 1915, inclusive.*

[Data presented through the courtesy of the Nebraska Agricultural Experiment Station.]

Group and variety.	Yield per acre (bushels).			
	1913	1914	1915	Average.
Fife:				
Marquis	6.8	4.3	20.2	10.4
Crimean (winter):				
Turkey [1]	17.3	8.0	31.1	18.8
Kubanka and Kahla (durum):				
Kubanka No. 1	7.7	3.9	25.1	12.2
Kubanka [2]	7.9	2.3	21.6	10.6
Kahla	9.8	2.9	19.2	10.6
Preston:				
Preston [3]	3.0	3.0	6.6	4.2

[1] Average yields from nine plats in the rotations of the Office of Dry-Land Agriculture Investigations.
[2] Average yield of two plats.
[3] This variety was grown under the name "Scotch Fife."

RESULTS AT AKRON, COLO.

At Akron, Marquis wheat has been compared with other winter and spring varieties during the 3-year period, 1913 to 1915, inclusive. The annual and average yields are shown in Table X, and the average results appear graphically in figure 6.

[1] Ball, C. R., and Clark, J. A. Varieties of hard spring wheat. U. S. Dept. Agr., Farmers' Bul. 680, 20 p., 7 fig. 1915.

The data show that here also the hard red winter wheats of the Crimean group outyield any spring wheat. The margin of advantage, however, is not wide. Considering only the spring wheats it is seen that the three durum varieties outyield any of the spring common varieties by 3 to 5 bushels per acre. Among the five spring common wheats, the Marquis ranks third, being slightly exceeded by the Ghirka Spring, of the Fife group, and a bearded variety called Red Russian, of the Preston group. Among the entire 11 varieties the Marquis ranks ninth.

TABLE X.—*Annual and average yields of the Marquis and seven other varieties of spring wheat and three varieties of winter wheat grown at the Akron Field Station, Akron, Colo., 1913 to 1915, inclusive.*

[Experiments conducted in cooperation with the Office of Dry-Land Agriculture Investigations.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3641	7.5	19.7	26.5	17.9
Ghirka Spring	1517	14.0	19.3	22.6	18.6
Glyndon	2873	8.0	16.6	16.2	13.6
Crimean (Winter):					
Kharkof 6P4	4207	18.5	26.1	28.3	24.3
Kharkof	1583	16.6	25.9	29.2	23.9
Do	1442	16.1	26.6	27.5	23.4
Pelissier and Kubanka (durum):					
Pelissier	1584	10.5	26.6	31.6	22.9
Arnautka	1493	10.5	27.6	27.9	22.0
Kubanka	1516	6.0	26.5	31.3	21.3
Preston:					
Red Russian	4141	8.3	23.0	23.9	18.4
Erivan	2397	12.0	19.3	19.5	16.9

RESULTS AT ARCHER, WYO.

At Archer the varietal experiments have included Marquis wheat during the three years, 1913, 1914, and 1915. The annual and average yields are shown in Table XI. The average yield of the highest yielding variety in each group is shown graphically in figure 6.

The results shown in Table XI are much like those obtained at Akron, Colo. The hard red winter wheats outyield any spring wheats, though they exceed the durums by only 1 bushel. The Ghirka Winter, a beardless winter variety, not shown in the table, gave an average acre yield of 18.2 bushels, or nearly 1 bushel more than the Turkey, the best variety of the Crimean group. The durums again outyield all spring common wheats. Among the latter, however, the Marquis leads. It outyields the next best variety of the Fife group, the Ghirka Spring, by 2 bushels, and the best Bluestem variety by 4.5 bushels. However, it exceeds the best of the Preston group by only 0.3 of a bushel.

TABLE XI.—*Annual and average yields of the Marquis and 11 other varieties of wheat grown on the Cheyenne Experiment Farm, Archer, Wyo., 1913 to 1915, inclusive.*

[Experiments conducted in cooperation with the Wyoming State Board of Farm Commissioners.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3641	9.0	8.4	21.0	12.8
Ghirka Spring	1517	9.2	10.0	13.2	10.8
Glyndon	2873	5.8	9.6	12.5	9.3
Crimean (winter):					
Turkey	1571	10.0	9.8	32.0	17.3
Kharkof	1442	9.8	4.7	37.1	17.2
Crimean	1559	9.7	3.2	38.6	17.2
Kubanka (durum):					
Beloturka	1520	7.7	11.9	28.9	16.2
Kubanka	1440	7.5	12.5	25.6	15.2
Preston:					
Red Russian	4141	8.3	10.2	19.0	12.5
Preston	3698	6.7	9.8	15.3	10.6
Bluestem:					
Haynes (Minn. No. 169)	2874	4.4	9.0	11.7	8.3
Haynes (Minn. No. 51)	1505	2.6	5.3	10.7	6.2

RESULTS AT NEWELL, S. DAK.

The experiments at Newell have included the Marquis variety during the 3-year period, 1913 to 1915, inclusive. The annual and average results are shown in Table XII. The yield of the best variety in each group is shown graphically in figure 6.

TABLE XII.—*Annual and average yields of the Marquis and eight other varieties of wheat grown on the Belle Fourche Experiment Farm, Newell, S. Dak., 1913 to 1915, inclusive.*

[Data obtained in cooperation with the South Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3276	16.8	8.0	50.9	25.2
Power	3025	16.6	5.1	43.4	21.7
Glyndon	2873	15.8	5.1	39.8	20.2
Crimean (winter):					
Kharkof	1442	38.6	28.7	63.8	43.7
Kubanka (durum):					
Pererodka	1350	16.7	9.7	58.2	28.2
Kubanka	1516	19.1	9.6	54.5	27.7
Arnautka	1493	17.1	9.5	54.9	27.2
Preston:					
Preston	3081	19.5	7.2	46.9	24.5
Bluestem:					
Haynes	3020	14.1	5.1	42.0	20.4

Here, as at the stations previously discussed, the hard winter wheats excel all spring wheats. The Kharkof outyields the Pererodka durum, the highest yielding spring variety, by 55 per cent. Again, the durum wheats outyield all groups of spring common wheats by good margins. The Marquis excels all other varieties of

spring common wheat. It outyields the Preston by only 3 per cent, but the Power and Glyndon by 14 and 20 per cent, respectively, and the Haynes by 19 per cent.

RESULTS AT HIGHMORE, S. DAK.

The Marquis variety has been included in the varietal experiments at Highmore during three years, 1913 to 1915, inclusive. The annual and average yields obtained from the Marquis and eight other varieties are shown in Table XIII. The average yield of the best variety in each group is shown graphically in figure 6.

The Marquis has outyielded all other varieties, both winter and spring, at Highmore during the period specified. The Kubanka and Preston are nearly tied for second place and do not fall far below the Marquis. The Kharkof, the hard winter variety, and the Haynes and three varieties of the Fife group fall from 4 to 11 bushels, or from 22 to more than 100 per cent, below the Marquis in yield. The comparatively high yield of the Marquis variety in 1913 was due to the favorable location of the plat in a low moist spot.

TABLE XIII.—*Annual and average yields of the Marquis and eight other varieties of wheat grown at the Highmore (S. Dak.) substation, 1913 to 1915, inclusive.*

[Experiments conducted in cooperation with the South Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3641	12.7	13.3	33.3	19.8
Power	2989	6.3	8.7	26.7	13.9
Ghirka	1517	6.5	11.3	16.7	11.5
Glyndon	2873	8.7	7.3	10.0	8.7
Kubanka (durum):					
Kubanka	1354	3.3	22.2	30.0	18.5
Do	1440	2.0	19.7	33.3	18.3
Preston:					
Preston	3081	6.5	12.0	35.8	18.1
Crimean (winter):					
Kharkof	1442	2.1	12.5	31.7	15.4
Bluestem:					
Haynes (Minn. No. 51)	1505	7.7	4.8	22.5	11.7

RESULTS AT EUREKA, S. DAK.

At Eureka the Marquis has been grown in the varietal test during only two years, 1914 and 1915. The annual and average yields are shown in Table XIV. The best yielding variety in each group and the average yield produced by it in the 2-year period are shown graphically in figure 6.

The results show that the Kubanka durum is the highest yielding among the five varieties tested. It outyields the Marquis by 3.5 bushels, or 15.5 per cent. The Marquis ranks second, exceeding the

Preston by 25 per cent and the Dakota Bluestem by 46 per cent. The Turkey, the only variety of hard winter wheat tested, was a complete failure in both years, except when mulched with straw.

TABLE XIV.—*Annual and average yields of the Marquis and four other varieties of wheat grown at the Eureka (S. Dak.) substation during 1914 and 1915.*

[Data obtained in cooperation with the South Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			Group and variety.	C. I. No.	Yield per acre (bushels).		
		1914	1915	Average.			1914	1915	Average.
Fife:					Bluestem:				
Marquis	3641	9.7	35.5	22.6	Dakota	3083	6.6	18.5	12.6
Kubanka (durum):					Crimean (winter):				
Kubanka	1440	9.3	42.9	26.1	Turkey	3055	0	0	0
Preston:									
Preston	3081	10.7	22.9	16.8					

RESULTS AT EDGELEY, N. DAK.

The experiments at Edgeley are conducted independently by the North Dakota Agricultural Experiment Station, and the results shown in Table XV have been made available through the courtesy of the director and other officers of that station. The experiments have included the Marquis during three years, 1913 to 1915, inclusive. The results are given in Table XV, and the yield of the leading variety in each group appears in figure 6.

Winter wheats are not grown at Edgeley. Durum varieties considerably outyield either the Fife or Bluestem groups of spring common wheat. The Marquis wheat excels all other varieties in the Fife and Bluestem groups. It outyields the Power, the next best Fife variety, by over 5 per cent and the Haynes by nearly 10 per cent.

TABLE XV.—*Annual and average yields of the Marquis and seven other varieties of wheat grown at the Edgeley (N. Dak.) substation, 1913 to 1915, inclusive.*

[Data used by courtesy of the North Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	N. Dak. No.	Yield per acre (bushels).			
			1913	1914	1915	Average.
Fife:						
Marquis		2700	26.6	10.5	32.0	23.0
Power (Sel.)	3025	312	30.6	7.0	27.9	21.8
Ghirka Spring	1517	2013	30.6	9.0	24.6	21.4
Power (Sel. N. Dak. No. 66)		920	26.9	5.5	31.0	21.1
Kubanka (durum):						
Arnautka	1494	778	25.2	15.5	43.4	28.0
Nicaragua	2006	543	25.2	15.5	38.2	26.3
Bluestem:						
Haynes (Minn. No. 51)	3021	779	26.9	5.0	29.9	20.6
American		872	25.1	3.5	28.9	19.2

RESULTS AT LANGDON, N. DAK.

At Langdon, as at Edgeley, the experiments are conducted independently by the North Dakota Agricultural Experiment Station, and the results are used here by courtesy of the director and his associates. The experiments have included the Marquis during only two years, 1914 and 1915. The annual and average results are shown in Table XVI and the yield of the leading variety of each group in figure 6.

The results may be seen at a glance. The two durum varieties far excel the Marquis and Glyndon. In the Fife group the Marquis outyields the Glyndon by 6 bushels, or more than 27 per cent. The yields of Bluestem varieties under the same conditions are not reported.

TABLE XVI.—*Annual and average yields of the Marquis and three other varieties of wheat grown at the Langdon (N. Dak.) substation during 1914 and 1915.*

[Data used by courtesy of the North Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	N. Dak. No	Yield per acre (bushels).			Group and variety.	C. I. No.	N. Dak. No.	Yield per acre (bushels).		
			1914	1915	Average.				1914	1915	Average.
Fife:						Kubanka (durum):					
Marquis	.....	2703	18.3	38.1	28.2	Kubanka	1440	929	31.7	46.1	38.9
Glyndon (Minn. No. 163)	2873	314	12.7	31.7	22.2	Gharnovka	1443	915	29.7	47.2	38.4

RESULTS AT WILLISTON, N. DAK.

The varietal experiments at Williston have included Marquis wheat during three years, 1913 to 1915, inclusive. The annual and average yields are shown in Table XVII, and the average yield of the leading variety in each group is shown graphically in figure 6.

At Williston, as elsewhere, the durum varieties excel any spring common wheats in yield. The best durum exceeds that of the Power, the best spring common, by 4.6 bushels, or nearly 14 per cent. Considering only the common wheats, the rank of the groups is Fife, Bluestem, Preston, and Crimean (winter), in the order named. Among the Fife varieties, the Power outyields the Marquis by 1 bushel, or 2.5 per cent. The Glyndon, in the Fife group, and the Dakota, a Bluestem variety, almost exactly equal the Marquis in yield. The yields of the winter-wheat varieties are very low.

The comparatively low yield of the Marquis in 1915 was due to damage by a late spring frost. The plants were about 8 inches tall at the time. Not only at Williston but also at other points in the State the Marquis seemed to be more seriously injured than other varieties.

TABLE XVII.—*Annual and average yields of the Marquis and 12 other varieties of wheat grown at the Williston (N. Dak.) substation, 1913 to 1915, inclusive.*

[Data obtained in cooperation with the North Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).				Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.			1913	1914	1915	Average.
Fife:						Bluestem:					
Marquis	3641	29.0	52.5	40.6	40.7	Dakota	3083	30.7	47.5	44.6	40.9
Power	3697	28.7	51.3	45.1	41.7	Haynes	2874	30.0	42.5	42.9	38.5
Glyndon	2873	28.2	49.2	44.1	40.5	Preston:					
Red Fife	3694	28.7	47.9	43.9	40.2	Preston	3698	25.0	46.3	43.4	38.2
Kubanka (durum):						Winter:					
Taganrog selection	1570	35.0	54.6	49.4	46.3	Buffum No. 17	3330	15.6	17.1	6.4	13.0
Kubanka	1440	33.0	53.8	47.3	44.7	North Dakota No. 1997	3084	13.1	15.8	6.1	11.7
Arnautka	3693	34.7	47.2	45.5	42.5	Beloglina	1543	7.8	10.0	12.8	10.2

RESULTS AT DICKINSON, N. DAK.

Marquis wheat has been grown at the Dickinson substation during three years, 1913 to 1915, inclusive. The annual and average yields obtained from this and other varieties are shown in Table XVIII. The average yield of the leading variety in each group is shown graphically in figure 6.

The results obtained are nearly the same as those at Williston. The durum wheats lead by a wide margin. The Marquis is the highest yielding variety of common wheat, and the Kubanka No. 8 excels it by nearly 35 per cent. The groups of common wheat rank in the same order as at Williston, namely, Fife, Bluestem, Preston, and Crimean (winter). The Marquis outyields the Rysting, the next best Fife variety, by 1.7 bushels, or 6 per cent, and the Preston by 2.7 bushels, or 11 per cent, while it exceeds the Crossbred Bluestem by 3.4 bushels, or 14 per cent. The winter wheats are not successfully grown in North Dakota.

TABLE XVIII.—*Annual and average yields of the Marquis and 12 other varieties of wheat grown at the Dickinson (N. Dak.) substation, 1913 to 1915, inclusive.*

[Data obtained in cooperation with the North Dakota Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).				Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.			1913	1914	1915	Average.
Fife:						Preston:					
Marquis	3641	24.2	14.0	32.8	23.7	Preston	3081	25.2	12.9	24.8	21.0
Rysting	3022	28.1	12.4	25.6	22.0	Preston	3328	26.2	7.2	25.9	19.8
Red Fife	3329	28.3	10.2	25.3	21.3	Bluestem:					
Ghirka Spring	1517	26.6	11.3	24.3	20.7	Crossbred	3314	27.1	10.1	23.7	20.3
Kubanka (durum):						Haynes	2874	24.8	8.3	22.9	18.7
						Crimean (winter):					
Kubanka No. 8	4063	31.2	13.0	51.5	31.9						
Kubanka	1440	26.7	14.2	48.5	29.8	Beloglina	1543	9.1	9.2	0	6.1
Arnautka 6P1	4064	30.9	11.6	44.8	29.1	Kharkof	1583	3.6	11.0	0	4.9

RESULTS AT MOCCASIN, MONT.

The varietal experiments at Moccasin have included Marquis wheat during the 3-year period, 1913 to 1915, inclusive. The annual and average yields obtained are given in Table XIX. The average yield of the leading variety in each group is shown in figure 6.

The hard red winter wheats of the Crimean group outyield all spring wheats at Moccasin by a margin of over 6 bushels per acre. Among the spring wheats the durums do not outrank the spring common wheats, as they have done at most of the other stations; in fact, the best varieties of durum, Fife, and Preston wheats are practically equal in yield. The Marquis leads the Fife varieties by a margin of over 5 per cent. The leading variety of durum wheat and the leading variety of the Preston group of common wheat outyield the Marquis, however, by the narrow margins of 1 and 3 per cent, respectively.

TABLE XIX.—*Annual and average yields of the Marquis and 11 other varieties of wheat grown at the Judith Basin substation, Moccasin, Mont., 1913 to 1915, inclusive.*

[Data obtained in cooperation with the Montana Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).				Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.			1913	1914	1915	Average.
Fife:						Preston:					
Marquis	3641	33.5	23.7	42.3	33.2	Fretes	1596	35.2	25.1	42.5	34.3
Power	3697	28.7	24.1	41.0	31.3	Preston	2959	29.2	22.4	41.6	31.1
Rysting	3022	26.7	23.0	40.6	30.1	Pelissier and Kubanka (durum):					
Glyndon	2873	20.0	22.7	41.0	27.9						
Crimean (winter):						Pelissier	1584	32.0	26.5	42.2	33.6
Kharkof	1583	31.1	30.3	61.3	40.9	Pererodka	1350	32.0	25.3	40.1	32.5
Do	1442	33.1	32.1	56.6	40.6	Kubanka	1440	30.7	23.0	40.7	31.5
Crimean	1559	35.3	30.8	54.1	40.1						

CONCLUSIONS.

The graphic portrayal in figure 6 and the facts given in Tables IX to XIX, inclusive, show that winter wheat is decidedly better than any spring wheat in much of this section. In central South Dakota and North Dakota, however, winter wheat can not be grown successfully.

Among spring wheats, the durums outyielded all the groups of common wheat at all of these stations, except Moccasin, Mont., and Highmore, S. Dak. At all the stations except Highmore, in central South Dakota, the durum wheats outyielded the Marquis variety. At Highmore the high yield of the Marquis wheat was due to the specially favorable location of the Marquis plat in a low spot in 1913. At Moccasin, Mont., however, the yields of the Marquis and the best durum variety were about equal.

The Marquis outyields the other Fife wheats or equals them in yield at all these stations except Williston, N. Dak., and Akron, Colo. At Williston the Power and at Akron the Ghirka Spring outyield the Marquis variety, but by only 2.5 and 4 per cent, respectively.

The Marquis outyields the Bluestem wheats at all stations except Williston, N. Dak., where the Dakota Bluestem very slightly exceeds it. The Marquis was damaged more than the other varieties by a late spring frost at Williston in 1915. This caused the lower average yield at this point.

The Marquis outyielded all varieties of the Preston group everywhere except at Moccasin, Mont., and Akron, Colo. At Moccasin the Fretes and at Akron the Red Russian outyielded the Marquis, but by only about 3 per cent in each case.

From these facts it is seen—

(1) That winter varieties are best where they can be grown in the northern section of the Great Plains area.

(2) That durums are better than any spring common wheats in this section.

(3) That the Marquis variety is better than any of the spring common wheats at some stations and about as good as any at most stations. The Marquis is a safe variety to grow anywhere in this section when spring wheat is to be grown.

The Marquis variety is especially well adapted to central South Dakota. Here drought and rust often reduce the yields of later maturing varieties. The Preston ("Velvet Chaff"), a bearded wheat, is now the leading variety in that district. The Marquis is beardless and a better yielder, as well as a better milling wheat.

Rust and drought are not so frequent in North Dakota and Montana. The earliness of the Marquis variety gives it an advantage when they do occur. The later maturing Fife and Bluestem varieties may give as high average yields in a longer series of years.

Results in the Western Basin and Coast Areas.

The dry lands of the States west of the Rocky Mountains are included under this heading. The different sections represented are known as the Great Basin, the Snake River basin, the Harney Valley, the Columbia Basin, and the Sacramento Valley. They include, therefore, the States of Utah, Idaho, Washington, Oregon, Nevada, and northern California.

Marquis wheat has been introduced commercially at a few places. Several carloads of seed are known to have been sold in the Columbia Basin counties of Washington. Similar introductions may have occurred in the Snake River basin also, but no record of such action is known. It is doubtful whether the variety has been introduced elsewhere in these areas. No statistics of production are available, but the total quantity must be very small.

Varietal experiments with Marquis wheat have been conducted on nonirrigated land at five experiment stations west of the Rocky Mountains. These stations include Nephi, Utah, Aberdeen, Idaho, and Burns, Oreg., where the experiments have included the Marquis variety during two years; Moro, Oreg., where the experiments have continued during three years; and Davis, Cal., where the variety has been grown but a single year. The locations of these stations

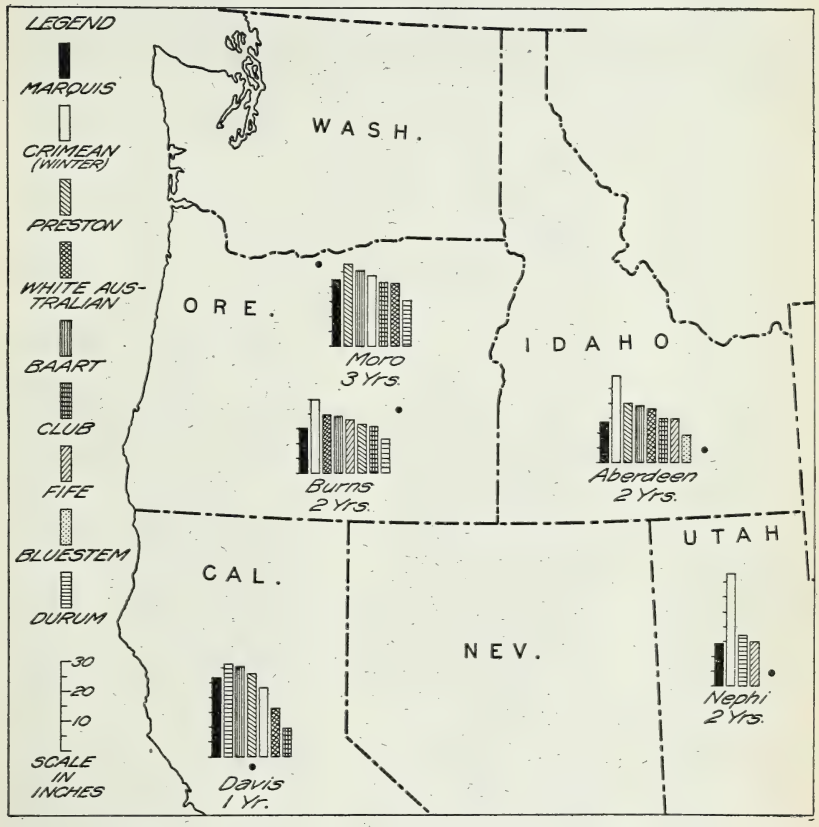

FIG. 7.—Diagram showing the average yields of the Marquis and the leading variety in each of several different groups of wheat at five dry-land stations west of the Rocky Mountains during one, two, or three of the years 1913 to 1915, inclusive.

and the average yield of the Marquis and also of the leading variety in each of several groups of wheat are shown in figure 7. The same data and those on still other varieties will be found in Tables XXI to XXV, inclusive. In figures 8 and 9 are shown heads and kernels of varieties representing the White Australian, Baart, and Little Club groups of soft white wheat, all of which are commercially important wheats in this section.

The climate of these basins and valleys is usually regarded as semiarid to arid. Table XX shows the elevation of each station and the recorded annual and seasonal precipitation during the years

FIG. 8.—Heads and kernels of three varieties of soft white wheat, natural size: 1, Palouse Bluestem; 2, Early Baart; 3, Little Club.

when the experiments herein reported were in progress, so far as the data are available.

These areas are characterized by low precipitation. Most of it falls during the autumn, winter, and spring months instead of during

the summer, as in the Great Plains area. This makes the seasonal rainfall small in proportion to the total, as will be noted in Table XX. For this reason, among others, winter wheats are more profitable and more extensively grown in these sections than spring varie-

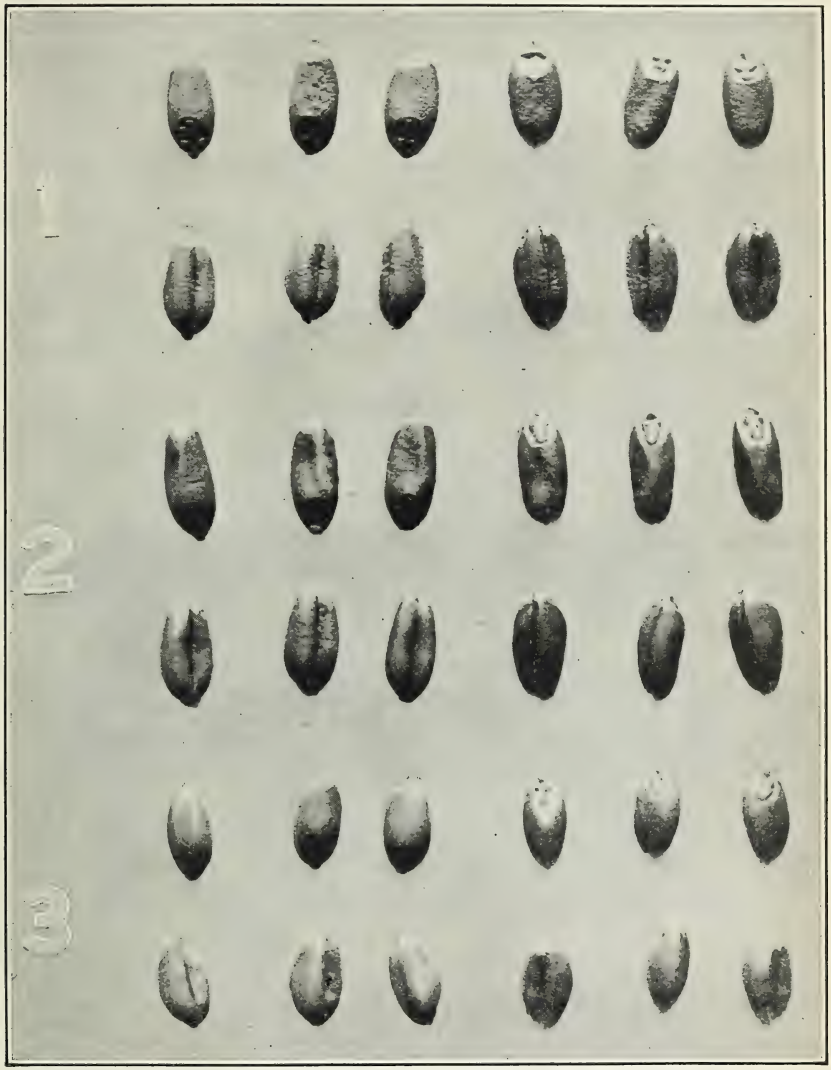

FIG. 9.—Kernels of three varieties of soft white wheat, shown in four different positions, twice natural size: 1, Palouse Bluestem; 2, Early Baart; 3, Little Club.

ties. Crop production is governed almost wholly by the quantity and distribution of the annual rainfall.

The elevation of these sections varies greatly. It is 6,000 feet or more in places, as in the Juab Valley, near Nephi, Utah, and in the

upper part of the Snake River Basin. Most of the surface lies at elevations of 4,000 to 5,000 feet. The Columbia Basin is much lower, scarcely exceeding 2,000 feet, while the Sacramento Valley of California reaches sea level at its lower end. Wind velocities are rather low in most of these areas. The summers are warm and evaporation fairly high. The growing season is short at the higher elevations. In the Harney Valley frosts occur during the summer months. Here, as elsewhere, early varieties of spring wheat have an advantage over midseason or late varieties.

TABLE XX.—*Altitude and annual and seasonal precipitation at five experiment stations in the arid western basin and coast areas.*

Station.	Altitude.	Precipitation (inches).							
		Annual.				Seasonal.[1]			
		1913	1914	1915	Average.	1913	1914	1915	Average.
	Feet.								
Nephi, Utah	6,000	.....	14.40	13.63	14.01	.....	5.85	5.54	5.70
Aberdeen, Idaho	4,400	.....	9.86	8.29	9.08	.....	4.20	3.91	4.06
Burns, Oreg.	4,100	.....	8.50	6.82	7.66	.....	4.28	3.06	3.67
Moro, Oreg.	1,800	12.17	11.32	14.86	12.78	4.30	3.56	3.64	4.50
Davis, Cal.	51	.....	.....	21.02	.....	.....	.....	14.43	.....

[1] The record for seasonal precipitation includes the months of April, May, June, and July at Aberdeen and Moro. At Nephi the record is for the three months, April, May, and June, and at Burns for the five months, April, May, June, July, and August. At Davis the record is for six months, January to June, inclusive.

RESULTS AT NEPHI, UTAH.

At the Nephi substation the cooperative experiments have included the Marquis variety for only two years, 1914 and 1915. The annual and average yields are shown in Table XXI. The average yield of the leading variety in each of the three groups is shown graphically in figure 7.

TABLE XXI.—*Annual and average yields of the Marquis and three other varieties of wheat grown at the Nephi (Utah) substation during 1914 and 1915.*

[Data obtained in cooperation with the Utah Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).		
		1914	1915	Average.
Fife:				
Marquis	3641	[a] 12.4	16.3	14.4
Ghirka Spring	1517	11.2	19.0	15.1
Crimean (winter):				
Turkey	2998	43.0	32.6	37.8
Crimean	1437	40.3	29.9	35.1
Durum:				
Adjini	1594	19.0	15.3	17.2
Kubanka	1440	15.7	18.2	17.0

[a] Yield in 1914 from a single row 121 feet long.

The data show the marked superiority of the hard red winter wheats over any spring wheats at the Nephi substation. The Turkey variety surpasses the Marquis by 165 per cent and the leading spring wheat by over 100 per cent. The durum varieties exceed the Marquis in yield by nearly 20 per cent. In the Fife group the Marquis is exceeded by the Ghirka Spring by nearly 5 per cent. The Marquis is thus the lowest yielder among the six varieties considered. The yield of the Marquis in 1914 is from a 121-foot row; in 1915 it is the average of four tenth-acre plats.

RESULTS AT ABERDEEN, IDAHO.

The cooperative varietal experiments conducted at Aberdeen, Idaho, have included Marquis wheat only during the last two years, 1914 and 1915. The annual and average yields of the Marquis and numerous other varieties are shown in Table XXII. The average yield of the best variety in each of the seven groups is shown graphically in figure 7.

The outstanding fact shown by Table XXII is that here again the varieties of the hard red winter or Crimean group of wheats strongly outyield all spring wheats. The best variety exceeds the Marquis by 110 per cent. The Fretes, Early Baart, and Palouse Bluestem, representing three different groups of spring wheat, outyield the Marquis by 44, 39, and 31 per cent, respectively. Even the Little Club excels the Marquis in yield by nearly 8 per cent. Considering finally the Fife group, the Ghirka Spring exceeds the Marquis by 8 per cent, while the Power almost equals it in yield.

TABLE XXII.—*Annual and average yields of the Marquis and 13 other varieties of wheat grown at the Aberdeen (Idaho) Branch Experiment Station during 1914 and 1915.*

[Data obtained in cooperation with the Idaho Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			Group and variety.	C. I. No.	Yield per acre (bushels).		
		1914	1915	Average.			1914	1915	Average.
Fife:					Baart:				
Marquis	3276	21.5	6.3	13.9	Early Baart	1697	31.1	7.5	19.3
Ghirka Spring	1517	26.1	4.9	15.0	White Australian:				
Power	3697	22.4	4.5	13.4	Palouse Bluestem	4067	27.5	9.0	18.2
Rysting	3022	20.1	3.6	11.8	Defiance	3703	19.7	6.3	13.0
Crimean (winter):					Dicklow	3663	18.3	6.3	12.0
Turkey	1571	38.5	20.2	29.3	Little Club:				
Kharkof	1442	29.3	21.1	25.2	Little Club	4066	22.9	7.2	15.0
Turkey	2998	25.6	22.5	24.1	Bluestem:				
Preston:					Haynes	2874	13.2	5.4	9.3
Fretes	1596	30.2	10.8	20.0					

RESULTS AT BURNS, OREG.

The Marquis variety has been included in the cooperative varietal experiment at Burns during two years, 1914 and 1915. The annual and average yields of the Marquis and other varieties, representing seven different groups of wheats, are shown in Table XXIII. The average yield of the highest yielding variety in each group is shown graphically in figure 7.

The results show that all the varieties in all the groups except the two durum varieties outyielded the Marquis by percentages varying from nearly 5 to over 64. The hard red winter wheats are again the highest yielders, though not so markedly superior as in Utah or even in Idaho. The Palouse Bluestem and Early Baart excel the Marquis here by more than 29 and 27 per cent, respectively. Two varieties of the Preston group, the Fretes and Erivan, outyield Marquis by nearly 10 per cent, while the Little Club excels it by about 5 per cent. In the Fife group, the Ghirka Spring again outyields the Marquis, this time by 19 per cent.

TABLE XXIII.—*Annual and average yields of the Marquis and 10 other varieties of wheat grown at the Harney Branch Station, Burns, Oreg., during 1914 and 1915.*

[Experiments conducted cooperatively with the Oregon Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			Group and variety.	C. I. No.	Yield per acre (bushels).		
		1914	1915	Average.			1914	1915	Average.
Fife:					Preston:				
Marquis	4158	9.3	21.3	15.2	Fretes	1596	13.3	20.0	16.7
Ghirka Spring	1517	15.7	20.5	18.1	Erivan	2397	12.7	20.3	16.5
Crimean (winter):					Little Club:				
Turkey	1558	19.3	30.7	25.0	Little Club	4066	13.7	18.0	15.9
Kharkof	1442	12.0	27.1	19.6	Kubanka (durum):				
White Australian:					Kubanka	2246	8.0	15.3	11.7
Palouse Bluestem	4067	16.7	22.7	19.7	Marouani	1593	7.2	16.0	11.6
Baart:									
Early Baart	1697	18.2	20.5	19.4					

RESULTS AT MORO, OREG.

At the Eastern Oregon Dry-Farming substation at Moro the cooperative varietal experiments have included the Marquis wheat during the 3-year period, 1913 to 1915, inclusive. The annual and average yields of the Marquis and numerous other varieties are shown in Table XXIV. The average yield of the best variety representing each group is shown graphically in figure 7.

The tabulated data show that the average yields of all groups except the durum lie between 21 and 28 bushels per acre. The hard red winter wheat here occupies about the middle of the scale, with a yield of 24 bushels per acre. At Moro the Marquis outyielded the Palouse Bluestem and Little Club about 5 per cent, but is excelled by the Early Baart by nearly 14 per cent. The highest yielding

variety of all is the Koola, of the Preston group, a spring wheat not yet grown commercially. The Koola outyielded the Marquis by 23 per cent in the 3-year test.

TABLE XXIV.—*Annual and average yields of the Marquis and eight other varieties of wheat grown at the Eastern Oregon Dry-Farming substation, Moro, Oreg., 1913 to 1915, inclusive.*

[Data obtained in cooperation with the Oregon Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	4158	22.1	22.5	23.1	22.6
Preston:					
Koola	2203-2	25.8	24.5	33.2	27.8
Baart:					
Early Baart	1697	25.0	25.5	26.6	25.7
Crimean (winter):					
Turkey	1558	24.0	27.5	20.6	24.0
Little Club:					
Little Club	4068	19.6	19.2	26.0	21.6
White Australian:					
Palouse Bluestem	4067	19.4	20.9	24.0	21.4
Kubanka (durum):					
Kubanka	1440	13.6	15.0	18.0	15.5

RESULTS AT DAVIS, CAL.

The experiments at Davis are conducted independently by the Agricultural Experiment Station of California, and the data are made available here through the courtesy of the director of the station and his associates. Marquis wheat has been grown there only in the year 1915. The yields of this and numerous other varieties, as well as the bushel weight of the seed, are shown in Table XXV. The yield of the highest yielding variety in each group is shown graphically in figure 7.

It will be appreciated readily that the yields of a single year afford no basis for conclusions. Three durum varieties and two spring common wheats, the Early Baart and Fretes, outyielded the Marquis. The season was abnormal, as may be seen by the low bushel weights, and rust was very prevalent.

In transmitting the data, Prof. John W. Gilmore writes as follows:

> The yields obtained in the variety trials with wheat in plats this season were very low, due largely to unfavorable weather conditions. The late spring rains caused the grain to lodge badly and also greatly increased the rust, so that the percentages of lodging and of rust infection this season were abnormally high. Then, too, the hot north winds which occurred during the ripening period caused the grain to shrivel badly instead of ripening as it should. The degree to which the grain was infected may be observed from the low weight per bushel of all varieties this season. * * *
>
> In comparing the results this season with past performances, it is further worthy of note that the yield of the White Australian checks was abnormally low in comparison with the other varieties. * * * The winter wheats this season gave much better results than usual, in comparison with the other varieties.

TABLE XXV.—*Yield per acre and weight per bushel of the Marquis and 13 other varieties of wheat grown at Davis, Cal., in 1915.*

[Data used by courtesy of the California Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre.	Weight per bushel.
		Bushels.	*Pounds.*
Fife:			
Marquis	.....	26.8	55.0
Unclassified durum:			
Marouani	1593	31.5	57.0
Durum × Club	4247	30.8	49.0
Velvet Don	2247–1	29.5	55.0
Baart:			
Imported Early Baart	.....	30.7	50.0
Early Baart	1697	21.3	51.5
Propo	1970	13.8	52.0
Preston:			
Fretes	1596	28.2	54.0
Chul	2227	15.7	47.0
Crimean:			
Turkey	.....	23.3	55.5
White Australian:			
Imported White Australian	.....	16.3	46.0
White Australian [1]	3019	15.3	41.7
California Gem	4248	8.0	37.0
Little Club:			
Little Club	3018	9.7	42.0

[1] Average of 16 check plats.

CONCLUSIONS.

The data in Tables XXI to XXV, inclusive, and in figure 7 show that the Marquis variety has not proved a high yielder at any station west of the Rocky Mountains. At three stations in Utah, Idaho, and Oregon, winter wheats outyield all spring wheats. At all five stations, other spring wheats outyield the Marquis. It is not as good, on the average, as the Palouse Bluestem, Early Baart, Fretes, or Ghirka Spring. It also is not as good as several of the new wheats which have been tested at these western stations but are not yet grown commercially. Marquis wheat is not recommended for any district west of the Rocky Mountains.

RESULTS IN IRRIGATED DISTRICTS.

Irrigated farming is confined to the valleys more or less adjacent to the mountains of the Western States. So far as known, Marquis wheat has not been grown commercially under irrigation.

Experiments to determine the value of Marquis wheat under irrigation conditions have been conducted at four different points. Two of these are east and two west of the Rocky Mountains. The stations are Newell, S. Dak.; Huntley, Mont.; Aberdeen, Idaho, and Fallon, Nev. The location of these four stations and the average yields of Marquis wheat and of the best variety in each of several groups of wheat are shown graphically in figure 10. The annual and average yields of the Marquis and several other varieties will be found in Tables XXVI to XXIX inclusive.

The normal rainfall at these points is of little importance, since irrigation water is supplied. One effect of the abundant water supply, however, is to lengthen the period required by the plant to reach maturity. Hence, early varieties are desirable where the elevation is sufficient to shorten the frost-free period. The altitude at Newell, S. Dak., as shown in Table VIII, is 2,950 feet above sea level. The altitude at Huntley, Mont., is 3,000 feet. The altitude of Aberdeen, Idaho, shown in Table XX, is 4,400 feet, while Fallon,

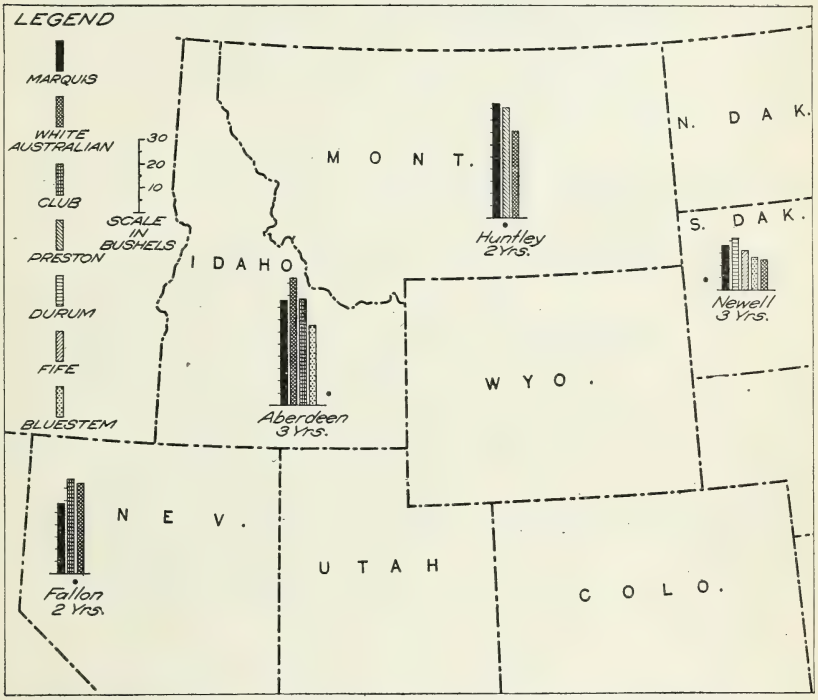

FIG. 10.—Diagram showing the average yields of the Marquis and the leading variety in each of several different groups of wheat under irrigation at four western stations in either two or three of the years 1913 to 1915, inclusive.

Nev., has an altitude of 3,965 feet. The growing season is of only medium length under these conditions. Sometimes it is much shortened by the occurrence of early autumn frosts. Early-maturing varieties, therefore, are best adapted to the conditions obtaining at these stations.

RESULTS AT NEWELL, S. DAK.

The experiments with wheat under irrigation at Newell, S. Dak., are conducted in cooperation with the Office of Western Irrigation Agriculture. Marquis wheat has been included in the varietal experiments during the 3-year period, 1913 to 1915, inclusive. The annual

and average yields obtained from the Marquis and four other varieties of wheat are given in Table XXVI. The average yield of each variety is shown graphically in figure 10.

The Marquis wheat has been compared with durum wheats and with varieties of common wheats of the Fife, Bluestem, and White Australian groups. The last named group consists of soft white wheats, extensively grown west of the Rocky Mountains and represented at Newell by the Defiance variety. The Kubanka durum outyields the Marquis by over 20 per cent. The Marquis, however, outyields the Power by 11 per cent, and the Haynes and Defiance by 25 and 30 per cent, respectively. The Marquis has been compared with winter wheat only in 1915, when the Kharkof, a Crimean or hard red winter wheat, yielded nearly four times as much as the Marquis.

TABLE XXVI.—*Annual and average yields of the Marquis and four other varieties of wheat grown under irrigation on the Belle Fourche Experiment Farm, Newell, S. Dak., 1913 to 1915, inclusive.*

[Data obtained in cooperation with the Office of Western Irrigation Agriculture.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3276	18.3	18.3	18.0	18.2
Power	3025	17.0	17.0	14.7	16.2
Kubanka (durum):					
Kubanka	1440	18.6	22.8	22.0	21.7
Bluestem:					
Haynes	2874	14.2	15.4	11.5	13.7
White Australian:					
Defiance	3703	11.7	18.0	8.0	12.6
Crimean (winter):					
Kharkof	1583	.....	.....	66.3	.....

RESULTS AT HUNTLEY, MONT.

The experiments at Huntley are conducted cooperatively by the Office of Western Irrigation Agriculture and the Montana Agricultural Experiment Station. The data here presented have been furnished by the Agriculturist in Charge of the Office of Western Irrigation Agriculture. The Marquis variety has been grown in varietal experiments during only two years, 1913 and 1914. The annual and average yields are given in Table XXVII. The average yield of the best variety in each group is shown graphically in figure 10.

At the Huntley station the Marquis variety has been compared only with spring common wheats. It has outyielded Pringle Champlain by 4 per cent; Stanley, a beardless variety with brown glumes, by 25 per cent; and Dicklow, by 32 per cent.

TABLE XXVII.—*Annual and average yields of the Marquis and four other varieties of wheat grown under irrigation on the Huntley (Mont.) Experiment Farm during 1914 and 1915.*

[Data furnished by the Office of Western Irrigation Agriculture.]

Group and variety.	Yield per acre (bushels).			Group and variety.	Yield per acre (bushels).		
	1913	1914	Average.		1913	1914	Average.
Fife:				Unclassified:			
Marquis	30.8	63.3	47.0	Stanley	27.1	47.9	37.5
Preston:				White Australian:			
Pringle Champlain	35.4	54.9	45.1	Dicklow	29.4	41.9	35.6
				Defiance	.....	56.0	.....

RESULTS AT ABERDEEN, IDAHO.

The Marquis variety has been grown under irrigation at Aberdeen during a 3-year period, 1913 to 1915, inclusive. The annual and average yields are shown in Table XXVIII. The average yield of the best variety in each group is shown graphically in figure 10.

Among the six varieties tested, the Marquis ranks fifth, outyielding only the Haynes. The yield of the Little Club is practically the same as that of the Marquis. The three varieties in the White Australian group, however, outyield the Marquis by 9, 14, and 31 per cent, respectively. The Defiance is commonly grown under irrigation in the Western States, while the Palouse Bluestem is the standard variety of spring wheat on the dry-land farms.

TABLE XXVIII.—*Annual and average yields of the Marquis and five other varieties of wheat grown under irrigation on the Aberdeen Experiment Farm, Aberdeen, Idaho, 1913 to 1915, inclusive.*

[Data obtained in cooperation with the Idaho Agricultural Experiment Station.]

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	Average.
Fife:					
Marquis	3276	33.3	38.9	56.7	43.0
White Australian:					
Dicklow	3663	61.5	38.0	56.7	52.1
Defiance	3703	55.6	43.5	47.7	48.9
Palouse Bluestem	4067	42.0	38.0	62.1	47.0
Little Club:					
Little Club	4223	41.3	41.2	47.7	43.4
Bluestem:					
Haynes	2874	36.0	27.4	35.1	32.8

RESULTS NEAR FALLON, NEV.

The varietal experiments with wheat on the Carson-Truckee Reclamation Project are conducted in cooperation with the Office of Western Irrigation Agriculture. In 1914 the experiments were conducted on the farm of L. W. Langford, and in 1915 on the farm

of A. R. Merritt. The results obtained are shown in Table XXIX. The average yield of the best variety in each group is shown graphically in figure 10. The two farms used for these experiments are about 20 miles apart. The results obtained in the two different years are not directly comparable. Since they agree fairly well, however, they have been averaged in Table XXIX and in figure 10.

Only spring common wheats have been compared with the Marquis in Nevada. Table XXIX shows that the Palouse Bluestem, Dicklow, and Little Club all outyield the Marquis by large margins. The overyields amount to 22, 28, and 33 per cent, respectively.

TABLE XXIX.—*Annual and average yields of the Marquis and three other wheats grown under irrigation on the Truckee-Carson Reclamation Project near Fallon, Nev., during 1914 (farm of L. W. Langford) and 1915 (farm of A. R. Merritt).*

[Data obtained in cooperation with the Office of Western Irrigation Agriculture.]

Group and variety.	C. I. No.	Yield per acre (bushels).			Group and variety.	C. I. No.	Yield per acre (bushels).		
		1914	1915	Average.			1914	1915	Average.
Fife:					White Australian:				
Marquis	3641	18.3	39.4	28.9	Dicklow	3663	30.7	43.2	37.0
Little Club:					Palouse Bluestem	4067	30.1	40.5	35.3
Little Club	4066	31.8	45.2	38.5					

CONCLUSIONS.

In Idaho and Nevada the soft white spring wheats, Dicklow, Defiance, Palouse Bluestem, and Little Club, all have outyielded the Marquis under irrigation. The Marquis wheat is not a profitable variety to grow under irrigation west of the Rocky Mountains.

In western South Dakota and in Montana the Marquis has given good results in comparison with other varieties of spring common wheat. The few data available indicate that it does not yield as well as the Kubanka durum and the Kharkof winter wheat.

SUMMARY OF YIELD DATA.

For convenience of comparison a summary of the average yields is presented in Table XXX. This summary contains the average yield of the most productive variety in each group at each station where it was grown. In all, 23 stations are represented. There are 25 different sets of experiments, however, as the varieties were grown under both nonirrigated and irrigated conditions at two stations. The Marquis and representatives of eight other groups are included.

The average yields of the same varieties at the same stations are also expressed in Table XXX in percentages of the yields of the Marquis variety. Arranging the data in this form makes comparison still more easy.

TABLE XXX.—*Average yields of the Marquis and of the highest yielding variety in eight different groups of wheat grown at 23 experiment stations in the western United States under humid, semiarid, arid, and irrigated conditions during part or all of the three-year period from 1913 to 1915, inclusive.*

YIELDS PER ACRE OF THE BEST VARIETY IN EACH GROUP (BUSHELS).

Division and station.	Number of years grown.	Marquis.	Crimean (winter).	Kubanka or Pelissier (durum).	Fife.	Bluestem.	Preston.	White Australian.	Baart.	Little Club.
Northern Prairie States:										
Ames, Iowa	2	16.5	41.2	.....	12.2	12.9	13.6	.....	.....	.....
Lincoln, Nebr	3	27.4	35.3	.....	.....	.....	26.0	.....	.....	.....
Brookings, S. Dak	3	23.9	36.1	20.1	12.0	15.7	19.5	.....	.....	.....
St. Paul, Minn	3	39.9	[a] 52.4	34.2	38.3	33.5	38.9	.....	.....	.....
Crookston, Minn	3	28.4	.....	26.8	.....	20.0	21.3	.....	.....	.....
Northern Great Plains area:										
North Platte, Nebr	3	10.4	18.8	12.2	.....	.....	4.2	.....	.....	.....
Akron, Colo	3	17.9	24.3	22.9	18.6	.....	18.4	.....	.....	.....
Archer, Wyo	3	12.8	17.3	16.2	10.8	8.3	12.5	.....	.....	.....
Newell, S. Dak	3	25.2	43.7	28.2	21.7	20.4	24.5	.....	.....	.....
Highmore, S. Dak	3	19.8	15.4	18.5	13.9	11.7	18.1	.....	.....	.....
Eureka, S. Dak	2	22.6	0	26.1	.....	12.6	16.8	.....	.....	.....
Edgeley, N. Dak	3	23.0	.....	28.0	21.8	20.6	.....	.....	.....	.....
Langdon, N. Dak	2	28.2	.....	38.9	22.2	.....	.....	.....	.....	.....
Williston, N. Dak	3	40.7	11.7	46.3	41.7	40.9	38.2	.....	.....	.....
Dickinson, N. Dak	3	23.7	6.1	31.9	22.0	20.3	21.0	.....	.....	.....
Moccasin, Mont	3	33.2	40.9	33.6	31.3	.....	34.5	.....	.....	.....
Western basin and coast areas:										
Nephi, Utah	2	14.4	37.8	17.2	15.1	.....	.....	.....	.....	.....
Aberdeen, Idaho	2	13.9	29.3	.....	15.0	9.3	20.0	18.2	19.3	15.0
Burns, Oreg	2	15.2	25.0	11.7	18.1	.....	16.7	19.7	19.4	15.9
Moro, Oreg	3	22.6	24.0	15.5	.....	.....	27.8	21.4	25.7	21.6
Davis, Cal	1	26.8	23.3	31.5	.....	.....	28.2	16.3	30.7	9.7
Irrigated districts:										
Newell, S. Dak	3	18.2	.....	21.7	16.2	13.7	.....	12.6	.....	.....
Huntley, Mont	2	47.0	.....	.....	.....	.....	45.1	35.6	.....	.....
Aberdeen, Idaho	3	43.0	.....	.....	.....	32.8	.....	52.1	.....	43.4
Fallon, Nev	2	28.9	.....	.....	.....	.....	.....	37.0	.....	38.5

YIELDS PER ACRE EXPRESSED IN PERCENTAGES OF YIELD OF MARQUIS.

Northern Prairie States:										
Ames, Iowa	2	100	249.5	.....	73.9	78.2	82.4	.....	.....	.....
Lincoln, Nebr	3	100	128.8	.....	.....	.....	94.9	.....	.....	.....
Brookings, S. Dak	3	100	151.0	84.1	50.2	65.7	81.6	.....	.....	.....
St. Paul, Minn	3	100	134.7	85.7	96.0	84.0	97.5	.....	.....	.....
Crookston, Minn	3	100	.....	94.4	.....	70.4	75.0	.....	.....	.....
Northern Great Plains area:										
North Platte, Nebr	3	100	180.7	117.3	.....	.....	40.4	.....	.....	.....
Akron, Colo	3	100	135.7	128.0	103.9	.....	102.7	.....	.....	.....
Archer, Wyo	3	100	135.2	126.5	84.5	64.8	97.7	.....	.....	.....
Newell, S. Dak	3	100	173.5	111.8	86.1	81.0	97.2	.....	.....	.....
Highmore, S. Dak	3	100	77.8	93.5	70.2	59.1	91.4	.....	.....	.....
Eureka, S. Dak	2	100	0	115.5	.....	55.8	74.4	.....	.....	.....
Edgeley, N. Dak	3	100	.....	121.7	94.8	89.6	.....	.....	.....	.....
Langdon, N. Dak	2	100	.....	137.9	78.7	.....	.....	.....	.....	.....
Williston, N. Dak	3	100	28.8	113.7	102.5	100.4	93.8	.....	.....	.....
Dickinson, N. Dak	3	100	25.7	134.6	92.9	85.6	88.6	.....	.....	.....
Moccasin, Mont	3	100	123.2	101.2	94.3	.....	103.8	.....	.....	.....
Western basin and coast areas:										
Nephi, Utah	2	100	262.5	119.5	104.8	.....	.....	.....	.....	.....
Aberdeen, Idaho	2	100	210.8	.....	107.9	66.9	143.8	131.0	138.8	107.8
Burns, Oreg	2	100	164.5	77.0	119.1	.....	109.8	129.5	127.6	104.6
Moro, Oreg	3	100	106.2	68.6	.....	.....	123.0	94.8	113.7	95.6
Davis, Cal	1	100	87.0	117.5	.....	.....	105.2	60.9	114.5	36.4
Irrigated districts:										
Newell, S. Dak	3	100	.....	119.2	89.0	75.3	.....	69.3	.....	.....
Huntley, Mont	2	100	.....	.....	.....	.....	96.0	75.8	.....	.....
Aberdeen, Idaho	3	100	.....	.....	.....	76.3	.....	121.1	.....	100.9
Fallon, Nev	2	100	.....	.....	.....	.....	.....	128.0	.....	133.2

[a] Average for only two years.

The data are summarized briefly as follows:

Wherever hard red winter wheat can be grown in the sections discussed, it outyields any spring wheat.

In the northern Prairie States the Marquis is the best variety of spring wheat. In the northern section of the Great Plains area durum wheats outyield spring common wheats. Among the latter the Marquis is the highest yielding variety.

West of the Rocky Mountains the Marquis is outyielded by the standard varieties of soft white spring wheat and by several newly introduced varieties. Under irrigation the Marquis has done fairly well in limited experiments east of the Rocky Mountains, but has not proved a good yielder at two stations west of this range.

MILLING AND BAKING QUALITY.

Experiments in milling and baking the Marquis and other standard hard spring wheats conducted by the North Dakota Agricultural Experiment Station [1] in 1913 and 1914 and by the Minnesota Agricultural Experiment Station [2] in 1913, have been published. An extensive series of experiments on the comparative milling and baking value of the Marquis and other spring-wheat varieties is now being conducted cooperatively by the North Dakota Agricultural Experiment Station and the Offices of Cereal Investigations and of Grain Standardization of the Bureau of Plant Industry.

The published data show that the Marquis wheat samples tested were equal or slightly superior in most respects to the samples of Fife, Bluestem, and Preston ("Velvet Chaff") wheats raised under similar conditions. A higher total yield of flour was obtained from the Marquis. The percentage of bran was less, while that of shorts was greater from the Marquis than from the three standard groups of spring common wheat. Compared with durum wheat, the Marquis is slightly lower in yield of flour and shorts but higher in yield of bran.

The baking quality of Marquis flour is high. It contains more crude protein than the flours of the three principal groups of spring common wheat. The amount of water absorbed by the Marquis flour in dough making also is high. These are important features in determining the expansive quality of the flour or its gluten. The loaf volume of the Marquis exceeds that of the other hard spring common wheats. There is comparatively little difference in the color, texture, and crumb of the Marquis and of the other spring common wheats.

In short, the data show the Marquis to be a first-class milling wheat.

[1] Ladd, E. F. Chemical and physical constants for wheat and mill products. N. Dak. Agr. Exp. Sta. Bul. 114, p. 273–297, 9 fig. 1916.

[2] Bailey, C. H. Marquis wheat. II. The milling quality of Marquis wheat. *In* Minn. Agr. Exp. Sta. Bul. 137, p. 9–14, illus. 1914.